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15.Abstract: This essay questions the wisdom of the current, almost exclusive focus on technology in discussions of transformation, arguing that it risks dooming US Armed Forces to expensive irrelevance and inconsequential lethality. We must explore intellectual and cultural components in determining how we will fight in the future, rather than merely concentrating on the tools we will use to fight. This essay will approach some cultural and intellectual components by proposing at set of warfighting tenets (decentralization, complexity, resilience, and tempo) that synthesize the enduring nature of war with contemporary technological realities. The key aspects of the enduring nature of war the essay addresses are: information is "essentially dispersed," war is Chaotic, combatants in war are complex adaptive systems, war is a nonlinear phenomenon, and war is uncertain. True transformation, the essay concludes, will be measured not by the speed of our microchips, but by the effectiveness of our soldiers, leaders, and organizations in the next war.

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Transforming How We Fight: A Conceptual Approach

By

Christopher D. Kolenda

MAJ, US Army

Submitted in consideration for the Admiral Richard G. Colbert Memorial Prize

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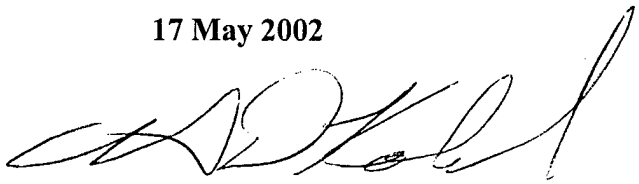

Introduction: Moving Beyond Technology

The apparent lessons from conflicts over the past ten years point to an emerging paradigm about transformation. Simply put, the increasingly popular Information Technology Revolution in Military Affairs (IT-RMA) thesis suggests that information superiority plus precision munitions equals victory.[1] Decision makers will have a "near omniscient view of the battlefield" which will enable them to direct precision munitions onto enemy targets and achieve such a rapid and lethal destructive effect that the enemy will be in "awe," "shock," or "paralysis," or that he will be "locked-out" of the objectives he wishes to pursue. Either way, the enemy will have no choice but to give up.

Imbedded in the paradigm are assumptions that future force structure should emphasize stand-off precision munitions delivered primarily from air or sea forces that will have maximum effect on the enemy with minimal risk to American life and collateral damage. A related assumption is that the omniscient view of the battlefield will make centralization of authority possible, and indeed inevitable.[2] Recent events in Kosovo and Afghanistan illustrate the new reality.[3] Indeed the Commander of US Central Command, General Tommie Franks, was apparently admonished for his Desert Storm-like plan for invading Iraq and told to make it "look more like Afghanistan."[4] The stakes of recognizing the true nature of the RMA and getting transformation right, therefore, are both paramount and immediate. Unfortunately, we have failed thus far.

By continuing to focus almost exclusively on technology in discussing transformation, the US armed forces risks developing strategies, force structures, and warfighting tenets that are at odds with the nature of war.[5] Secretary of Defense Donald

H. Rumsfeld has argued rightly that transforming America's military means more than developing technology. We must, he asserts, change "how we think about war," and encourage a culture of creativity and risk-taking.[6] Transformation, therefore, has important intellectual and cultural components that must turn technological advances into a more effective military.[7] Considerations of those other components of transformation, however, have devolved into little more than the glib hype of exhausted adjectives.[8] Failure to come to grips with cultural and intellectual elements of transformation might doom the US Armed Forces to expensive irrelevance and inconsequential lethality.

It is time to question to validity of the prevailing IT-RMA thesis and offer alternative concepts that move the US Armed Forces along the path of true, rather than merely technological, transformation. This essay will approach some cultural and intellectual components by proposing at set of warfighting tenets that synthesize the enduring nature of war with contemporary technological realities. It seeks to help bridge the gap between new technology and true transformation. In so doing, this paper will explore briefly the following five critical aspects of the nature of war:

1. Information in war is "essentially dispersed."
2. War is Chaotic.
3. Combatants in war are Complex Adaptive Systems.
4. War is a Nonlinear phenomenon.
5. War is Uncertain.

The insights from those aspects of the nature of war suggest that the future will belong to the force that masters the following warfighting tenets:

1. *Decentralization*: create and exploit a knowledge advantage by empowerment at the appropriate levels.
2. *Complexity*: gain a complexity advantage by maximizing the number of meaningful interactions with which the enemy must cope simultaneously or near-simultaneously.

3. *Resilience*: sustain balance and equilibrium in our own force while creating and exploiting instability and disorder in the enemy.
4. *Tempo*: create and sustain an intensity of operations over time with which the enemy cannot cope.

Nature of War: Some Key Aspects

Information in War is Essentially Dispersed

Economist Friedrich von Hayek (1900-1992) argued that information is "essentially dispersed" in the "extended market order." Although economic theory often translates uneasily from a business to a military context, Hayek's concept is useful in terms of analyzing individual and collective human behavior. The idea provides a conceptual foundation that can enable leaders to liberate and harness the creative genius of their people and organizations.

Hayek viewed the market as an evolutionary process of discovery and adaptation in which individuals gathered, processed, and interpreted information and made choices to maximize their interests. What appears to be a chaotic market is, in fact, a "spontaneous order" that is beyond any centrally designing intelligence.[9] "Modern economics explains how such an extended order can come into being," suggests Hayek, "and how it constitutes an information-gathering process, able to call up, and put to use, widely dispersed information that no central planning agency, let alone any individual, could know as a whole, possess, or control."[10]

Hayek argues that information, knowledge, and understanding are "essentially dispersed" in space and time. Human beings perceive, interpret, and understand information and make decisions that reflect the lenses through which they view the world. In the terms of modern psychology, the rationality of individuals is bounded by

factors such as experiences, biases, education, and emotions.[11] As a result, two people can look at the same picture and derive completely opposite conclusions and take radically different courses of actions to pursue their interests.

The apparent dissonance can be explained, in part, by the difference between explicit and tacit knowledge. Explicit knowledge is meaningful information that can be entered into data-bases and information systems. Tacit knowledge is implicit information and processing capabilities that individuals carry inside of them as a result of their cognitive maps and perceptual lenses.[12] Tacit knowledge comes into existence and manifests itself in ways peculiar and specific to context.[13] It is drawn upon only in particular circumstances. It shapes the manner in which we behold information; in how we create knowledge and understanding and the degree to which each is relevant and appropriate to the situation.

The essentially dispersed nature of information suggests that the fusion of explicit knowledge onto a situational awareness screen does not result automatically in homogeneity of interpretation and decision.[14] Different people will look at the same situation and will observe different crises and opportunities. They will make different assessments of risk. And they will ultimately make different decisions about how to maximize the effectiveness of themselves and their organizations. Shared situational awareness of physical relationships on the battlefield does not mean shared appreciation for how to act upon the information. The essentially dispersed nature of information will remain salient in Information Age warfare. Our challenge is to use leverage it by liberating the creative genius of professionals.

War is Chaotic

Chaos Theory is a relatively new and complex branch of science and mathematics, the implications of which for human systems have only begun to be explored.[15] Chaos contends a certain complex order in a system that is determined by each element within it and each force that acts upon it. Elements within the system interact with one another and with external inputs to the system. They also interact with the "feedback" from the first interactions, creating "system perturbations" (subsequent orders of effects) that shape the system and make it unpredictable. The result is a peculiar order unique to each Chaotic system.

Chaos does not necessarily imply disorder. A Chaotic system can be stable or unstable. A Chaotic system is stable if "its particular brand of irregularity" persists in the face of disturbances (inputs) or if it returns to its particular brand of irregularity over time. The inputs can create responses from the system that are immediately unpredictable but stable over time.[16] Conversely, a Chaotic system is unstable if inputs result in a permanent change in its regime of behavior or nature.[17] Chaotic systems are thus complex and deterministic.[18] Because of the system's complexity, predicting the precise impact of an input or interaction with absolute fidelity is impossible.

War is a Chaotic system.[19] Clausewitz argued that "war is more a true chameleon that slightly adapts its characteristics to the given case." The dominant tendencies in war, the famous trinity (passion, probability and chance, and reason) and triangle (people, military, and government) give the combatants in particular and the war in general unique characteristics. "Our task therefore is to develop a theory that maintains a balance between these three tendencies, like an object suspended between three magnets."[20] Such

insight is an implicit recognition of the Chaotic nature of war and of the combatants that participate in it.[21]

In a similar vein, Clausewitz described the criticality of "moral factors" as the true measurement of an organization's combat capability. He eschewed the attempt to reduce war to fixed formulas, equations, and calculations of raw numbers.[22] The continuing interaction of opposites on deterministic systems makes war uncertain and unpredictable. Strength in moral factors gives resilience to the organization, but such resilience is not a fixed quantity either – moral factors can grow or recede over time. A strong and confident army can become demoralized; an unconfident and untested force can develop high morale. The Chaotic nature of war endures. The challenge is to develop ideas on how to turn it to our advantage.

Complex Adaptive Systems

Human organizations are complex and adaptive.[23] The individuals and teams within the system react to inputs and adapt to changes. Sometimes those adaptations are consciously designed to maintain system effectiveness in the face of a threatening input or to capitalize upon an opportunity for growth or value maximization. Others are subconscious or unconscious adaptations.[24] Morale and confidence, for instance, might decrease as efforts to cope with interactions prove futile or, conversely, might increase as those efforts are successful.

War is not an isolated act. Interactions take place simultaneously on various levels. The organization and the individuals within in are adapting constantly to themselves (internal emotions, biases, experiences, education, etc.), to those around them,

to the enemy, and to external forces and factors.[25] As long as the system remains resilient, it will attempt to adapt effectively to crises and opportunities. As the system becomes more fragile, the ability to sustain effectiveness erodes, and adaptations to accomplish other purposes (such as individual survival in war) can rise to the fore.

Evolutionary biology theory lends insight into the unpredictability of complex interaction among Chaotic systems.[26] Although it is possible in hindsight to trace the development of a species, for instance, predicting it in advance is not possible.[27] Too many unique factors intervene to determine the outcome. As in Chaotic systems, the result is deterministic, but not predictable.[28] The outcomes of interaction, therefore, have effects that alter the general situation and impact the choices of others. They shape the nature of future interactions and thus have continued orders of effects as the war unfolds.[29]

When applied to war, the concept of adaptive complexity suggests that the number of possible outcomes increases unpredictably with the number of meaningful inputs.[30] As each side adapts those inputs, the interactions can generate effects and responses that defy predictions and expectations.[31] Looking backward from the outcome one can see readily how the interactions unfolded in a logical, understandable manner.[32] From the perspective of the observer in time and space, however, the resultant was one of myriad possibilities. The adaptive complexity of war renders it unpredictable.

War is Nonlinear

The Chaos and adaptive complexity of war render it a nonlinear phenomenon.[33] A linear outcome is one in which the strength of the input yields a symmetrical strength

of output. A nonlinear outcome is one that is not directly proportional to the input.[34] Nonlinear systems, as historian Alan Beyerchen explains, "are those that disobey proportionality or additivity. They may exhibit erratic behavior through disproportionately large or disproportionately small outputs, or they may involve 'synergistic' interactions in which the whole is not equal to the sum of its parts."[35] In a nutshell, a nonlinear outcome is one that defies the logic and science of linearity.

Nonlinear systems are living, animate, and adaptive. They can change over time and with context due to interaction.[36] As Chaos and complexity theories suggest, the alterations that result can transform the system into a qualitatively different nature or regime of behavior. Nonlinearity helps to explain why even subtle inputs to the system can yield disproportionately large outputs, and, conversely, why large inputs can have only minor effects.[37] Small changes to initial conditions in a fragile system can lead to outcomes that defy proportionality, while large inputs to a resilient system can be absorbed. The same input can also yield different outcomes at different times because the nature of the system is dependent upon context.[38] As Alan Beyerchen summarizes, "The heart of the matter is that the system's variables cannot be effectively isolated from each other or from their context; linearization is not possible, because dynamic interaction is one of the system's defining characteristics."[39]

The importance of recognizing war as a nonlinear phenomenon is that no single formula, equation, methodology, or capability can predict the outcome or guarantee victory. The effects of inputs can be disproportionately large or small. They can cause "system perturbations" in which unintended consequences arise that require attention. Coping with them leads to subsequent orders of effects that could scarcely be anticipated

but nevertheless change the situation fundamentally.[40] Effective adaptation to war's unpredictability will remain an essential challenge.

War is the realm of uncertainty

The very nature of war renders it uncertain.[41] Prevailing concepts of uncertainty, however, do not address the issue adequately. Uncertainty is commonly understood as a matter of information.[42] If this is the case, then the argument that information superiority, or "dominant battlespace knowledge," can "lift the fog of war" is plausible.[43] Uncertainty, however, is not reducible to information. To be sure, simple uncertainties, those unknown but attainable pieces of existing information, can be reduced radically by information technology. But simple uncertainties merely scratch the surface of the issue.

Another type of commonly appreciated uncertainty, and one not necessarily reducible to existing information, concerns the future. According to one influential study, such uncertainties can be grouped into four categories. The first is called a Clear Enough Future in which the forecast is precise enough for strategic development. Although the inexactitude of human endeavor will make absolute certainty impossible, the future points inexorably toward a single strategic direction. Next are Alternate Futures in which a few discrete outcomes are plausible. Third is a Range of Futures in which the actual outcome can lie anywhere along a broad continuum bounded by that range, but no discrete outcomes are obvious. True Ambiguity is the last category. In this case there is no basis upon which to forecast the future.[44] Between uncertainties that result from gaps in existing information and those over scenarios of the future, however,

are several other types of uncertainty that are impossible to predict precisely but that have a determining effect.[45]

Intrinsic Uncertainties result from bounded rationality – those factors that can create a gulf between perception and reality. Cognitive biases, emotions, assumptions, experiences, education, and heuristics are all factors that shape the meaning people elicit from information. Two individuals can look at the same data and derive completely opposite conclusions from it, and consequently can make fundamentally different decisions. Particularly in complex, unique, and ambiguous environments, the decisions and actions that result due to bounded rationality can be highly unpredictable.

Frictional Uncertainties deal with the inability to determine precisely how friction will manifest itself. Equipment failures are part of the friction of war. More prevalent, however, are frictions that result from poor communication between people, fear, danger, exhaustion, disobedience, initiative, will, inertia, and other human factors. These frictions can affect individuals and organizations that defy prediction and expectation.

Dynamic Uncertainties are the most problematical because they result from interaction. The concepts of Chaos, adaptive complexity, and nonlinearity illustrate the inherent unpredictability present in war when forces interact. An input that generates a certain response from one system will likely generate a much different response from another. Destroying the communications network of one combatant, for instance, might lead to such disruption that the combatant will not continue the war. The same input to another combatant might merely increase the intensity of the resistance. The outcomes that result from complex interaction, therefore, defy prediction.[46] Adding the challenges

of intrinsic and frictional uncertainties, as well as those of competing vision and forecasts of the future, exacerbates the problem.

Under the old paradigm coping with uncertainty has traditionally meant collecting more information, refining analysis, and developing strategic postures. In so doing, the decision-maker must have an appreciation for what is knowable and accessible and what is not. He or she must also understand the amount of resources required to gain additional information and determine whether the effort is worthwhile. The decision-maker then develops strategies to shape or adapt to developments and to determine the right "portfolio of actions" for the response.[47] Uncertainty was something to be overcome (information) or something to "bind" (anticipating the future).

The existence of frictional, intrinsic, and dynamic uncertainties suggests that the old paradigm is incomplete. First, coping with uncertainty requires the deliberate creation of resilience to manage the effects of inputs and interaction on the system. Chaos, adaptive complexity, and nonlinearity suggest that instability and fragility in the system can lead to unpredictable, disproportionate, and dysfunctional outcomes. Coping in advance with uncertainty requires creating the conditions necessary for resilience in the system. Second, it demands the need for versatility and flexibility to respond to crises and opportunities in a manner that derives maximum advantage from the situation. Last, it argues for the development of an approach to war that focuses on the creation and exploitation of uncertainty in the enemy.

Warfighting Tenets: Moving Beyond Technology

The combatant that understands the nature of war and can best cope with and exploit it will have a decided advantage in war. This different conceptual approach has the potential to open new and more appropriate pathways toward real transformation. It also can serve as a reference point from which to evaluate the IT-RMA thesis and to suggest alternatives. The following four warfighting tenets serve as approaches to transformation that move beyond myopic focus on technology.

Decentralization: create and exploit a knowledge advantage by empowerment of people at the lowest possible level.

The notion that information is essentially dispersed in the extended order of the battlefield, coupled with the fact that shared information does not necessarily equate to a shared appreciation for how to act on such information, leads to fundamental questions regarding how organizations should be commanded and controlled. One part of the issue concerns whether a centralized or decentralized approach is more effective.[48]

The increased transparency of the battlefield makes the impulse for centralization more difficult to control. With a nearly "omniscient" view of the battlefield, the argument goes, a very senior commander will have "dominant battlespace knowledge" necessary to make rapid and sound decisions. The interconnectedness of the organization will enable the commander to transmit those decisions instantaneously to subordinates and will also permit more precise monitoring of how those orders are implemented. The core assumptions of this argument are that shared information leads to shared understanding, that decisions are made most effectively at higher echelons of

organization, and that organizations consist of "decision entities" that control "actor entities" with networks permitting fewer of the former to control more of the latter. Such centralization of authority, however, would guarantee sub-optimal transformation.

Myriad studies in the behavioral sciences illustrate that bounded rationality is intrinsic to human nature. One of the implications is that different people can look at the same information and arrive at different conclusions about it. Consequently, one person can perceive a crisis and will act conservatively to deal with it. Another person can see the same picture and recognize a fleeting opportunity worth taking significant risk. Centralizing authority has the unfortunate consequence of limiting battlefield understanding to a single "decision entity." Vesting authority exclusively in a senior commander might seem a safer course of action because that individual, by virtue of experience and education, is less likely to make a poor decision than a more junior commander. In so doing, however, the creative tension that results from alternative perspectives is lost.[49]

Moreover, removing the sense of responsibility, ownership, and empowerment of junior leaders decreases motivation, retards creative thinking and problem solving, and results generally in less effective execution. Decisions are not necessarily executed in the manner foreseen or intended, and this tendency increases with the psychological distance between decision-maker and actor.[50] Empowerment of professionals at the lowest possible levels is the most effective guarantor of excellence. We should permit our technology to help unleash the power of our people rather than handcuff it.[51] The idea that information is essentially dispersed furthers the case for decentralization.[52] Unleashing the creative genius of people can create a certain complex order in the

operation that no authority could centrally conceive or direct and that no enemy will be able to fully comprehend or counter.

Information in the hands of people who cannot act on it is worth little. Information in the hands of empowered people can create complex synergies of unimaginable power. We can guarantee sub-optimal performance by centralizing authority while placing relatively powerless people in harm's way. We can, on the other hand, create a culture of empowerment that truly transforms how we operate. Technology is neutral in this regard. Such culture depends upon the maturity and self-control of senior leaders to empower professional subordinates and promote innovative thinking and responsible risk-taking while resisting the urge to micromanage affairs. It also relies upon junior professionals to rise to the challenge and opportunity.[53]

Complexity: gain a complexity advantage by maximizing the number of meaningful interactions with which the enemy must cope simultaneously or near-simultaneously.

Complexity increases with the number of meaningful interactions occurring at multiple levels simultaneously. It also rises when response to one interaction creates "system perturbations" to which a combatant must respond. The most effective way to gain the complexity advantage is by combining the concept of effects-based operations with joint capabilities.[54]

The notion that stand-off precision munitions alone will generate the right effects and result in the psychological collapse of the enemy is at odds with the idea of adaptive complexity. A thinking enemy who is determined to win will develop methods to mitigate the effects of stand-off precision munitions.[55] Despite their destructive power,

stand-off precision weapons, when pursued in isolation, have limited psychological impact. Shock value erodes rapidly over time, and the effects of stand-off precision munitions can be countered with relative few adverse consequences.

A balanced approach to war that emphasizes the synergistic employment of precision-strike and ground maneuver forces is a far more effective method. Simple measures designed to avoid a PGM threat will increase vulnerability to the ground maneuver threat, and vice versa. Moreover, the increased number of options available to a balanced force will complicate further the range of problems with which the enemy must cope. Faced with such challenges, the enemy is far more likely to make critical self-defeating errors. By making our actions more unpredictable, we create further uncertainty for the enemy and increase the likelihood for inducing cognitive or psychological collapse.[56] Effects-based operations pursued with balanced joint capabilities that maximize the number of meaningful interactions with which the enemy must cope is the most effective way to increase complexity. While cognitive or psychological collapse is not guaranteed with such an approach, the potential is far greater than when a single capability is employed alone.

Resilience: sustain balance and equilibrium in our own force while creating and exploiting instability and disorder in the enemy.

Related to complexity is the concept of resilience. Chaotic, complex adaptive systems such as combatants at war range from resilient to fragile. Resilient systems can absorb inputs and sustain or quickly return to their "normal" regimes of behavior; fragile systems become disordered and incoherent.[57] Such systems are inherently nonlinear.

Resilient systems can retain integrity despite disproportionately large inputs, defying what linear science would predict as the outcome. Conversely, fragile systems can lose their integrity due to disproportionately small inputs. We see such outcomes in war routinely – the small resilient unit withstands and defeats an attack despite being vastly outnumbered; the defending unit collapses entirely in the face of an attack by a numerically weaker foe.[58] We cannot predict with certainty the exact nature of input that will result in disproportionate outcomes, but we can approach the Chaotic, complex, and nonlinear natures of war from the perspectives of resilience and fragility in order to tilt the outcomes of interaction in our favor.

Clausewitz described the nature of combatant states in terms of the trinity and triangle, and the strength of armed forces based upon physical strength, moral factors, and the relative genius of the commander. Although such a framework is not perfect, it does capture significant "points of attraction" that together will influence the degree of resilience in the system.[59] Combatants in war must cultivate and sustain resilience by attending to the points of attraction whether at the state, armed forces, or unit level. Critically important during our transformation efforts is to attend to factors that influence morale, cohesion, and leadership with the same amount of energy and enthusiasm we devote to technological development.

The opposite side of the coin naturally concerns the enemy's degree of resilience. We must also direct operations at creating and exploiting fragility in the enemy in order to induce nonlinear outcomes in our favor. A note of caution is in order, however, prior to assuming that collapse is inevitable through the employment of any single-type capability. Some enemies are indeed fragile and the possibility exists that stand-off

precision munitions alone could bring about the collapse foretold by some theorists. A more resilient enemy, however, might very well sustain the will to fight in the face of such an attack, particularly if that enemy knows we will not employ ground forces. Relying on the assumed fragility of the enemy's will is simply irresponsible.

We cannot control the enemy's will necessarily, but we can create the conditions in which retaining the will to fight becomes increasingly difficult. By maximizing the level of complexity and exploiting fragility we create the greatest possible effect on the enemy's will. Whether and when the will of the enemy breaks under such pressure is dependent ultimately on the nature of the enemy. The complexity generated by properly employing a balanced, joint force will create the conditions necessary for successful military operations whether the enemy possesses a strong or weak will. Understanding the nature of combatants and the relationships between complexity and resilience provides a sounder approach to warfighting than exclusive focus on technology.

Tempo: create and sustain an intensity of operations over time with which the enemy cannot cope.

The concept of tempo integrates decentralization, complexity, and resilience. Breaking the enemy's will to resist rarely results from a single spike in the intensity of operations. The following respite will enable the enemy to recover, adapt, and continue to fight. Instead, we need to create and maintain intense, complex interactions over a sustained period of time. Operations that generate nested effects and force maximum interactions at each level of war, when continued over time, has the best potential to break the enemy's will.

Such operations require a level of structural resilience and balance in organizations to sustain tempo without hitting the walls of capability or human endurance.[60] We must eliminate the operational pauses (transitions) that result from having too few forces to sustain a fight or from an improper mix of forces that cannot dominate the fight despite the effects of terrain and weather.[61]

Studies of combat psychiatry and nonlinear dynamics indicate that disproportionate outcomes due to cognitive or psychological collapse occur when the system, whether the human or the organization, does not have time to recover equilibrium.[62] Our ability, then, to sustain constant pressure against the enemy's points of leverage becomes crucial. We must possess the capability to deny the enemy periods of rest in transitions between offense and defense or between successive offensive or defensive operations. To do so, not only must we have a balanced force, but a force robust enough to win the initial fight and then commit fresh units to maintain pressure during the transitions while the previously engaged units recover.[63] The enemy determines whether and when he will collapse cognitively or psychologically, but our capability to nest meaningful effects at the tactical, operational, and strategic levels and to dominate the transitions in war to deny the enemy the ability to recover equilibrium, will stretch his moral factors to the limit.

Conclusion

John Boyd's conceptual spiral provides important insight to help us grapple with transformation.[64] Exploring technological improvement is important, but pursued in isolation will only lead us so far. We must simultaneously examine desired operational

capabilities and cultural and intellectual concepts that express how we want to fight. The synergistic interaction of analysis and synthesis among each broad category leads to innovation that is greater than any single approach can contribute on its own. The warfighting tenets suggested herein aim to begin the process of filling important conceptual voids in our efforts to transform.

We will fail if we focus exclusively on technology. One of the problems with technological evolutions and RMAs is that the first ones to experience such changes do not necessarily come to grips with them most effectively.[65] To be successful we must integrate technological and conceptual change in a manner consistent with the enduring nature of war. Decentralization, complexity, resilience, and tempo can serve as guideposts for meaningful transformation.

Information technology can radically improve the speed at which orders are transmitted, can create a forum for meaningful dialogue between commanders during the fight as they struggle to interpret reality between what they see on the ground and what they see on the computer screen, can enable commanders to apply combat power quickly to exploit fleeting opportunities, and can lead to an order of magnitude increase in the tempo of operations. The common operating picture can help commanders unleash the creative energies of their subordinates while ensuring that independent actions and decisions remain within the framework of the commander's intent.[66] The true magic of high performing organizations is that empowered subordinates, guided by vision and parameters from seniors, creatively employ their interdependent efforts in a manner that leads to the success of the whole organization. Rather than tightening the bonds of rigid

control, information technology in the hands of mature and thoughtful leaders should lead to a significant increase in empowerment and effectiveness throughout the organization.[67]

True transformation will be measured not by the speed of our microchips, but by the effectiveness of our soldiers, leaders, and organizations in the next war. We need to stimulate and unleash the creative genius of our people. We must develop leaders with intellectual courage who understand the theory and history -- the art and science -- of their profession, who can combine education and experience into wisdom, and who can cope with the enduring nature of war and turn it to their advantage. We need to develop resilient organizations that are cohesive, trained, confident, and ready to fight and win. Implementing warfighting concepts and doctrines that promote resilience and agility while generating higher complexity and operational tempo than the enemy can handle will assure dominance even if an enemy can match or mitigate our technological advantage. A balanced, truly joint force armed with resilient and adaptable leaders, versatile organizations, and sound warfighting concepts and doctrines will form the foundation for a truly effective and dominant military in the 21st century.

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[1] In more sophisticated terms: information superiority leads to "dominant battlespace knowledge" that will "lift the fog of war" and assure victory. For examples of the IT-RMA thesis see, for instance, Admiral Bill Owens. *Lifting the Fog of War* (New York: Farrar, Straus and Giroux, 2000); David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare* (Washington DC: CCRP Publications, 1999); Stuart E. Johnson and Martin C. Libicki, Dominant Battlespace Knowledge (Washington DC: National Defense University Press, 1996); Colonel David A. Deptula, "Firing For Effect: Change in the Nature of Warfare" (Arlington, VA: Aerospace Education Foundation, Defense and Airpower Series, 1995); Fareed Zakaria, "Face the Facts: Bombing Works," *Newsweek* (December 3, 2001); Colonel John A. Warden, "Employing Air Power in the Twenty-First Century," in Richard H. Shultz, Jr. and Robert L. Pfaltzgraff, Jr., eds. *The Future of Air Power in the Aftermath of the Gulf War* (Montgomery, AL: Maxwell Air Force Base, Air University Press, 1992); Thomas L. Mahnken, "War in the Information Age," *Joint Force Quarterly*, No. 10 (Winter 95/96), 39-43.

[2] Eliot Cohen, "A Revolution in Warfare," *Foreign Affairs* (Spring 1996), 48-50.

[3] See the very interesting article on the effects of live video feeds to higher headquarters on tactical decision-makers engaged on the ground: Thomas E. Ricks, "Beaming the Battlefield Home: Live Video of Afghan Fighting had Questionable Effect," *Washington Post* (March 26, 2002).

[4] Rowan Scarborough, "Size of Force on Ground Key in Plan for Iraq War," *Washington Times* (April 26, 2002).
[5] See, for instance, Paul Van Riper and Robert H. Scales, "Preparing for war in the 21st Century," *Parameters* (Autumn 1997), 5, 14. The article, however, is more of a critique of the IT-RMA thesis than a discussion of how to apply new technologies to enhance warfighting effectiveness.
[6] Donald H. Rumsfeld, "Transforming the Military," *Foreign Affairs* (May/June 2002), 29.
[7] See the Department of Defense, *Quadrennial Defense Review Report*, Washington DC: US Government Printing Office, September 30, 2001, iv-v.
[8] A typical passage from *Network Centric Warfare* (p. 151) illustrates the point:

> That is to say that organizational behavior could be consciously designed to be an emergent property that derives from the commander's intent, as internalized by actor entities, the degree of battlespace knowledge available and the ability of decision entities to minimize the constraints imposed on actor entities by virtue of the resources allocated to actor entities.

What this passage attempts to convey is difficult to ascertain. My point is not to belittle the book or its authors – the work represents some of the very best innovative technological thinking to date on transformation – but to highlight the challenge of articulating new intellectual and cultural concepts in a clear and meaningful manner.
[9] See "In Praise of Hayek," *The Economist*, 28 March 1992, p. 75. Quoted in Barry D. Watts, "Clausewitzian Friction and Future War," McNair Paper 52 (Washington DC: Institute for National Strategic Studies, National Defense University, 1996), 70.
[10] F.A. Hayek, in The Collected Works of F. A. Hayek, ed W. W. Bartley III, vol 1, *The Fatal Conceit: The Errors of Socialism*, 14. Cited in Watts, 70.
[11] For discussions of bounded rationality see Robert Axelrod, "Schema Theory: An Information Processing Model of Perception and Cognition." *The American Political Science Review*. 67 (December 1973), 1248-1266 and *Structure of Decision: The Cognitive Maps of Political Elites*. Princeton: Princeton University Press, 1976; Richard Heuer, "Cognitive Factors in Deception and Counterdeception." In *Strategic Military Deception*, ed. Donald Daniel and Katherine Herbig (New York: Pergamon, 1982); Daniel Kahneman, Paul Slovic and Amos Tversky, *Judgment under Uncertainty: Heuristics and Biases* (Cambridge: Cambridge University Press, 1987). Discussions of bounded rationality emerge in ancient Greece. Plato's Myth of the Cave is an example of bounded rationality. According to Plato, we do not see things as they really are. As individual bound by chains in a cave with our backs to the lights, we see only images and shadows of things represented on the wall of the cave. Plato did suggest, however, that a philosopher could break the chains of perception and turn around, climb out of the cave, and reach the light. From there, he could see things as they really are. See Book VII in Bloom, *The Republic of Plato* (New York: Basic Books, 1991). See also Aeschylus, *Prometheus Bound.* Translated by H. Weir Smith (Cambridge: Harvard University Press, Loeb Classical Library, 1988).
[12] Watts, 76. John Boyd argued that the "orientation" process of the OODA loop is shaped by genetic heritage, cultural tradition, previous experiences, and unfolding circumstances. I have subsumed these issues and more under the rubrics of cognitive maps and perceptual lenses.
[13] According to Hayek:

> Much of the particular information which any individual possesses can be used only to the extent to which he himself can use it in his own decisions. Nobody can communicate to another all he knows, because much of the information he can make use of he himself will elicit only in the process of making plans for action. Such information will be evoked as he works upon the particular task he has undertaken in the conditions in which he finds himself... Only thus can the individual find out what to look for, and what helps him to do this in the market is the responses others make to what they find in their own environments... The market is the only known method of providing information enabling individuals to judge comparative advantages of different uses of resources of which they have immediate knowledge and through whose use, whether they so intend or not, they serve the needs of distant unknown individuals. This dispersed knowledge is essentially dispersed, and cannot possibly be gathered together and conveyed to an authority charged with the task of deliberately creating order.

See Hayek, 77; cited in Watts, 71.

[14] I have seen myriad examples of such discontinuities at the Army's combat training centers. A typical criticism is that commanders and staffs routinely fail at predictive analysis because they do not interpret "indicators" correctly. The observer-controllers often feed information from higher intelligence sources to the army unit to exercise the process of predictive analysis. Knowing the enemy's plans, the observer-controllers often gaze in wonder at how the commanders and staff process and interpret the information and make assessments that are completely at odds with what the "indicators" should show. The meanings of the indicators are obvious to the observer-controllers because they have the whole story and they have foreknowledge of the enemy's plans. The player unit, without benefit of such foreknowledge, and subject to the frictions of stress, interprets and processes the information in a way that is indeed reasonable according to their cognitive maps and perceptual lenses in the context. It just so happens that their predictions of the future are often completely incorrect.

[15] I will capitalize "C" when referring to Chaos as a science and use the lower-case when referring to disorder. For an excellent introduction into Chaos theory see James Gleick, *Chaos: Making a New Science* (New York: Viking Press, 1988) and Glenn E. James, "Chaos Theory: the Essentials for Military Applications." *The Newport Papers #10* (Newport: Naval War College, College of Naval Warfare Studies, 1996).

[16] Weather patterns are examples. We know that temperatures are higher in the summer than in the winter, we know when hurricane and monsoon seasons begin and end, we know when snowfall is likely and when it is not. Within those large parameters, however, we cannot predict with certainty exactly when the hurricane will hit and where, the temperature on a specific day a month in advance, or how many inches of snow will fall on a given ski resort on a given day two weeks from now. See James Gleick, *Chaos: Making a New Science* (New York: Viking Press, 1988), 48.

[17] A military organization with low morale and capability, for instance, can collapse completely when attacked by a more effective force. Likewise, a change in leadership can alter the morale of an organization radically.

[18] Every input and interaction affects the system. Some are absorbed and the system returns to normal, some alter the system permanently. A robust, or resilient, system is stable; it retains its character in the face of input. A fragile system is unstable – it alters fundamentally due to input.

[19] The Chaotic nature of human systems is due, in part, to the complexity of the individuals that comprise it, the complexity of interactions among individuals, the inputs external to the organization, and the responses and adaptations, individually and collectively, to those inputs and interactions

[20] The above quotations are from Carl von Clausewitz, *On War*, edited and translated by Michael Howard and Peter Paret (Princeton: Princeton University Press, 1984), 89.

[21] As historian Alan Beyerchen observes,

> But when a pendulum is released over three equidistant and equally powerful magnets, it moves irresolutely to and fro as it darts among the competing points of attraction, sometimes kicking out high to acquire added momentum that allows it to keep gyrating in a startlingly long and intricate pattern... The probability is vanishingly small that an attempt to repeat the process would produce the exact same pattern.

Alan Beyerchen, "Clausewitz, Nonlinearity, and the Unpredictability of War," *Parameters* (Winter 1992), 69-70. Clausewitz was an avid observer of science and it is quite possible, according to biographer Peter Paret, that he witnessed such a demonstration and decided to include it as a metaphor in On War. See Peter Paret, *Clausewitz and the State: The Man, His Theories and His Times* (Princeton: Princeton University Press, 1983), 310.

[22] According to Clausewitz,

> An irreconcilable conflict exists between this type of theory and actual practice... [Those theories] aim at fixed values; but in war everything is uncertain, and calculations have to be made with variable quantities. They direct the inquiry exclusively toward physical quantities, whereas all military action is entwined with psychological forces and effects. They consider only unilateral action, whereas war consists of continuous interaction of opposites.

Clausewitz, 134, 136.

[23] The best discussions of complex, adaptive systems are Robert Jervis, *System Effects: Complexity in Political and Social Life* (Princeton: Princeton University Press, 1999) and "From Complex Systems: The

Role of Interactions," in Tom Czerwinski (ed.), *Coping with the Bounds: Speculations on Nonlinearity in Human Affairs* (Washington DC: CCRP Publications, 1998).

[24] A way to appreciate complexity and its potential in war is by contrasting it with simple and compound systems. A simple system is linear: the force of a single input will generate a proportional and predictable output. Decision-making in simplicity is fairly easy. The combatant must respond only to a single threat. For instance, the presence of a bomber overhead will elicit a predictable "scatter" response from a ground unit. To escape the effects of the bomber the ground unit disperses.

A compound system, on the other hand, is one in which two or more inputs are present that force a combatant to make choices. Often times the choice to avoid one threat will increase the combatant's vulnerability to another threat. This time, the ground unit is facing both a bomber and an opposing ground force. The best reaction to the bomber is dispersion, but that choice will make the ground force more vulnerable to the opposing ground force. Conversely, the best choice to oppose the ground force is to concentrate the friendly ground forces. Doing so, however, makes the friendly ground force more vulnerable to the bomber. The commander is essentially on the "horns of a dilemma." The combination of threats in a specific battle or context increases the challenge for the enemy. Compound systems account for interaction at the friendly versus enemy level.

A complex system is one in which interactions take place on multiple levels at once: self, friendly forces, enemy forces, and the external environment in its totality. In war, commanders interact with themselves – their own emotions, goals, biases, and experiences – and their staffs as they attempt to cope with war's complexity while simultaneously trying to accomplish the war's purpose. Commanders and organizations also interact with friendly forces. At the strategic level this can be interaction with the people and the government. At the operational and tactical levels this can mean interaction with adjacent forces or other instruments of national power. The activities of friendly forces shape the context in which our own operations take place. In a similar vein, there is interaction with the external environment. Examples of external forces are, among others, political directives, coalitions, the physical environment, and third party inputs to the system.

[25] In terms of the organization itself, a commander for instance interacts with himself and his organization, with other friendly forces, with the enemy, and with external inputs from higher headquarters, the environment, civilians on the battlefield and myriad others. Interactions also take place at different levels of war: tactical, operational, and strategic. Actions at one level will have effects at the other levels.

[26] A useful way to look at the process of adaptive complexity is through the idea of "speciation." The earliest point at which a new species can be discerned is called a speciation event. The mitochondria in the cells of the species are the fingerprint from which one can determine commonality. In the human species, the female line is the one that passes along the mitochondria. All of the people alive today are, theoretically, the offspring of the "Mitochondrial Eve" – the most recent direct ancestor of every human being alive today.

Her status as the "Mitochondrial Eve" is dependent upon contingencies in her own times as well as circumstances in later ones. Future contingencies are shaped by the initial choices and actions of the "Mitochondrial Eve," but are not determined by them. Subsequent outcomes are also shaped by choices and actions through the passage of time. In hindsight we can, in theory, trace a logical sequence of decisions, actions, and outcomes, all the way back to her. Such reconstruction in hindsight, in fact, would result in a logical chain of events that would seem obvious at each point along the way. From the perspective of foresight, however, today's "Mitochondrial Eve" was but one candidate of many over the expanse of time and humanity, impossible to select in advance. Indeed, the actual "Mitochondrial Eve" might appear to be the least obvious among the different possible candidates. The complexity and subtleties of interaction and adaptation make outcomes over time increasingly unpredictable.
Daniel C. Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life* (New York: Simon and Schuster, 1995), 97. See also Watts, 73.

[27] Darwin's central thesis of evolution is that the rich diversity of species come about "chiefly through the natural selection of numerous successive, slight, favorable variations; aided in an important manner by the inherited effects of the use and disuse of parts; and in an unimportant manner, that is in relation to adaptive structures, whether past or present, by the direct action of external conditions, and by variations which seem to us in our ignorance to arise spontaneously." Cited in Watts, p. 80. Charles Darwin, *Origin of the Species by Means of Natural Selection*, in *Great Books of the Western World*, Robert Maynard Hutchins,

ed. Vol. 49 (Chicago: Encyclopaedia Britannica, 1952), 239; see also Ernst Mayr, *The Growth of Biological Thought: Diversity, Evolution, and Inheritance.* (Cambridge: Belknap Press, 1982), 394-534.

[28] Darwin's theory of natural selections is not without its flaws, but as one observer notes, the core thesis is the only empirical theory that is capable "of solving that most difficult of problems posed by life anywhere in the universe, namely, the problem of the existence of adaptive complexity." Cited in Watts, 81. Richard Dawkins, "Darwin Triumphant: Darwinism as a Universal Truth," in Michael H. Robinson and Lionel Tiger, eds., *Man and Beast Revisited* (Washington, DC: Smithsonian Institution Press, 1991), 38; Richard Dawkins, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design* (New York: W. W. Norton, 1987), 317.

[29] For a similar analysis of friction see Stephen J. Cimbala, *Clausewitz and Chaos: Friction in War and Military Policy* (Westport, CT: Praeger Press, 2000), 200-1.

[30] By "meaningful inputs" I mean inputs to the system that require decisions from leaders and actions from organizations. The level of importance of the inputs is determined by the degree to which they affect the combatants.

[31] See Watts, 79.

[32] See, for instance, the study by Fred Charles Iklé, *Every War Must End* (New York: Columbia University Press, 1971) "... the final outcome of wars depends on a much wider range of factors, many of them highly elusive – such as the war's impact on domestic politics or the degree to which the outside powers will intervene" (p. 1-2).

[33] Nonlinear dynamics is a branch of science that seeks to explain why systems in the real world routinely do not respond as predicted by classical mathematics and Newtonian physics. For discussions of Nonlinearity see Czerwinski, *Coping with the Bounds.*

[34] Linda P. Beckerman, "The Non-Linear Dynamics of War," *Science Applications International Corporation*, 1999. www.belisarius.com/modern_business_strategy/beckerman/non_linear.htm, p. 2.

[35] Alan Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War," p. 62.

[36] Military organizations often exhibit nonlinearity. The quality of leadership, for instance, can have a significant impact on the combat effectiveness of an organization. As the quality of leadership changes over time, the organization can demonstrate very wide ranges of effectiveness. Combat stress on a unit can also become transformational. What was a superb outfit after two weeks in combat can become a dysfunctional one after two months at the front.

[37] Nineteenth century scientist James Clerk Maxwell explains the limitations of seeing the world solely through the straitjacket of linearity:

> When the state of things is such that an infinitely small variation of the present state will alter only by an indefinitely small quantity the state at some future time, the condition of the system, whether at rest or in motion, is said to be stable; but when an infinitely small variation in the present state may bring about a finite difference in the state of a system in a finite time, the condition of the system is said to be unstable. It is manifest that the existence of unstable conditions renders impossible the prediction of future events, if our knowledge of the present state is only approximate, and not accurate ... it is a metaphysical doctrine that from the same antecedents follow the same consequences. No one can gainsay this. But it is not of much use in a world like this, in which the same antecedents never again concur, and nothing ever happens twice... The physical axiom which has a somewhat similar aspect is "That from like antecedents follow like consequences." But here we have passed from sameness to likeness, from absolute accuracy to a more or less rough approximation.

James Clerk Maxwell, "Science and Free Will," in Lewis Campbell and William Garnett, with a new Preface and appendix by Robert H. Kargon, *The Life of James Clerk Maxwell* [1882], 440-2. Quoted in Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War," 64. See also, Roche and Watts, p. 194; Coe and Dockery, p. 22; Watts, "Clausewitzian Friction," 105-123.

[38] See also James G. Roche and Barry D. Watts, "Choosing Analytic Measures," *The Journal of Strategic Studies*, vol. 14, no. 2 (June 1991), 165-209, and Watts, 194.

[39] Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War," p. 66.

[40] One powerful example of nonlinear behavior comes from Samuel Huntington's *Clash of Civilizations*:

> More generally, even small amounts of violence between people of different civilizations have ramifications and consequences which civilizational violence lacks. When Sunni gunmen killed

eighteen Shi-ite worshippers in a mosque in Karachi in February 1995, they further disrupted the peace in the city and created a problem for Pakistan. When exactly a year earlier, a Jewish settler killed twenty-nine Muslims praying the Cave of the Patriarchs in Hebron, he disrupted the Middle Eastern peace process and created a problem for the world.

In this case, context was absolutely crucial in generating nonlinear behavior that disrupted the already fragile peace process in the Middle East. See Samuel P. Huntington, *Clash of Civilizations and the Remaking of World Order* (New York: Simon and Schuster, 1996), 254.

[41] For an in depth examination of uncertainty in war see Christopher D. Kolenda, "Uncertainty in War: Exploring the Nature of Combat and Conflict," (Newport, RI: Naval War College, Advanced Research Project, 2002).

[42] For instance, Frank M. Snyder, "Command and Control and Uncertainty." *Naval War College Review*, (March-April 1979), Admiral Bill Owens, *Lifting the Fog of War*, 14, 15. Robert Leonhard seems to argue along similar lines in asserting an inverse proportionality between "knowledge" and "ignorance." See *Principles of War for the Information Age* (Novato, CA: Presidio Press, 1998), 251.

[43] For further discussion See Owens, *Lifting the Fog of War* and Stuart E. Johnson and Martin C. Libicki (eds.) *Dominant Battlespace Knowledge* (Washington DC: National Defense University Press, 1996).

[44] Hugh Courtney, Jane Kirkland, and Patrick Viguerie, "Strategy Under Uncertainty," Harvard Business Review (November/December 1997). Reproduced in *Strategy and Force Planning*, 3rd Edition (Newport, RI: Naval War College Press, 2000), 37-41. Vision is another part of uncertainty about the future, not addressed in the above study, that must be added to the construct. Vision is an attempt to create an image of the future and then to develop plans, policies, and programs to achieve it. Imbedded is a degree of doubt, conscious or otherwise, over whether the vision is the correct or best one. The enemy attempts to achieve vision as well, and these competing visions and implementation schemes can undermine existing plans, create unforeseen opportunities and crises, and can even make an existing vision absolutely untenable.

[45] See Kolenda, "Uncertainty in War," 47-58.

[46] The interactions and counteractions and the resulting changes and adaptations that take place create such complexity that the interacting systems defy modeling by anything less complex than themselves.

[47] Courtney *et al*, "Strategy under Uncertainty," 43-51. The authors suggest three strategic postures: shape the future, adapt to the future, and reserve the right to play; and three payoff profiles in a portfolio of action: no-regrets moves, options, and big bets.

[48] For discussions of centralization versus decentralization see Christopher D. Kolenda, "Discipline: Creating the Foundation for an Initiative-Based Organization," in Kolenda (ed.) *Leadership: The Warrior's Art* (Carlisle, PA: Army War College Foundation Press, 2001) and Dandridge M. Malone, "The Integration of Internal Operating Systems: An Application of Systems Leadership," in Robert L. Philips and James G. Hunt (eds.), *Strategic Leadership: A Multi-Organizational Perspective* (Westport, CT: Quorum Books, 1992). Another part deals with the question of organizational structure: should we "flatten the hierarchy" and develop "networked" organizations or is the current structure still useful? Due to the increased capacity for control afforded by network-centric organizations, the organizational structure can be flattened to remove unnecessary and redundant layers of commanders and staff. In light of the war on terror, as one argument posits, the only way to defeat a networked organization is with a networked organization. See John Arquilla, David F. Ronfeldt, and Michele Zanini, "Networks, Netwar, and Information-Age Terrorism," in Ian O. Lesser *et al* (ed.), *Countering the New Terrorism*. The RAND Corporation, 1999. So called networked organizations, however, seem to thrive when operating in a negative integration paradigm. They are good at nihilistic destruction, but have difficulty building cohering platforms for action. Nationalist organizations, for instance, while effective in undermining existing governments or fighting foreign forces, have traditionally experienced severe difficulties in attempting to build for the future. Hence, we should exercise caution prior to assuming that a networked organization is intrinsically more effective than a well-functioning hierarchical system. For further study on nationalism and nationalist organizations see John Hutchinson and Anthony D. Smith (eds.) *Nationalism* (New York: Oxford University Press, 1994).

[49] The fear of subordinate leaders making sub-optimal decisions can be addressed through training and education, see Kolenda, "Discipline."

[50] Distance, in this case can be viewed as psychological distance between leader and subordinate. As the psychological distance grows, the subordinate might feel less responsible for successful implementation of a decision or plan. The stronger the identity of an actor with a decision, the more likely the actor will feel a sense of ownership and a desire to see it implemented properly.

[51] Centralization of authority on the extended order of the battlefield can serve as a hedge against subordinates making decisions contrary to the desires of the senior. It also guarantees the sub-optimization of any capable subordinate in that organization. Empowering subordinates, on the other hand, enables them to maximize their contributions to the fight – it creates a level of complexity, tempo, and performance beyond the power of a centralized authority to imagine or replicate. It carries with it the risk that empowered individuals might make sub-optimal decisions (or worse decisions than the senior would in that situation), particularly because they are less experienced than the senior. The effectiveness of our transformation will hinge in many ways upon the extent to which we harness the power of essentially dispersed information on the extended order of the battlefield.

[52] Empowered professional individuals and leaders throughout an organization will make decisions and take actions designed to maximize the contributions of themselves and their organizations toward achieving the commander's intent. When coupled with the levels of excellence created by ownership and sense of responsibility, this complex order will increase the effectiveness of our operations by an order of magnitude.

[53] Although recent conflicts have left senior leaders with relatively little to do other than micromanage affairs, a conflict of greater complexity just might come along that demands senior leader attention at the appropriate levels and the resultant faith in junior leaders to perform without direct and overwhelming supervision. The direction we take during transformation concerning centralization versus decentralization of authority might just make the difference between winning and losing.

[54] For discussions of effects-based operations see Arthur Cebrowski, "President's Forum" and Edward A. Smith, "Network-centric Warfare: What's the Point?" *Naval War College Review* (Winter 2001) . Theorists of maneuver warfare and network-centric warfare recognize the Chaotic nature of war. They call for operations aimed at generating effects upon the enemy's will to create paralysis, shock, and dislocation rather than merely focusing on the physical destruction of the enemy's forces. They recognize implicitly that interactions that create dysfunctional instability in the enemy's system can result in the loss of will to fight. Nesting effects on the enemy's command and control structures, on the morale of enemy armed forces, and on a combatant's economic infrastructure are examples of such methods. The degree to which such operations are successful, however, depends upon the ability to generate the destabilizing inputs and upon the resilience of the enemy. For essays on the necessity of balance in force structure see Robert Scales, *Future Warfare Anthology* (Carlisle, PA: Strategic Studies Institute, 1999).

[55] Placing air defense sites, command and control facilities, and other critical assets next to hospitals, places of worship, and highly populated areas are adaptations designed to take advantage of American aversions to civilian casualties and collateral damage. Dispersing and hiding armored forces, using decoys, and relying more heavily on small-unit infantry operations are some ways to limit the effectiveness of precision munitions. Multi-role chemical factories that can make pharmaceuticals and baby formula as well as chemical and biological weapons are also adaptations.

[56] Employing ground forces does increase the potential for US casualties, and therefore, critics argue, might undermine the war effort in a casualty-averse society. A number of problems exist with this argument. First, casualty aversion seems to have far more to do with the stakes of the war than a reflexive impulse to avoid putting Americans in harm's way. Second, as we learned in Kosovo, taking ground troops "off the table" simplified the conflict for the Serbians and led to a belief that they could endure the bombing while completing the ethnic cleansing of the province. Such myopic rationality on the part of NATO to avoid casualties by taking away the ground force option highlights a third problem: making adaptations easier by simplifying the war for the enemy can prolong the conflict thereby actually increasing the total number of casualties and amount of destruction. For relevant polling data for War on Terrorism see CNN/USA Today/Gallup, ABC News/Washington Post, and CBS News September 12, 2001; Washington Post/ABC News November 8, 2001 and contrast with polls concerning US forces deploying to Bosnia in CNN/USA Today December 15-18, 1995.

[57] It is also possible for inputs to strengthen or weaken a system. For instance, a change to better leadership, a battlefield victory, and refitting can make an organization more resilient, whereas a change to

poor leadership, a series of defeats, and lack of logistical support can erode resilience and make an organization more fragile.

[58] For further discussion see Kolenda, "Uncertainty in War."

[59] While physical strength is important, for instance, a large force with poor morale and incompetent leadership is far more fragile than a smaller force with high morale and superb leadership.

[60] See Watts, 82-89.

[61] Transitions are characterized by pauses in war as each side prepares for a subsequent operation. The period between initial deployment and the conduct of offensive or defensive operations is a transition. The pause that results when an offensive operation culminates and the unit prepares to defend or resume the offensive is another type of transition. Likewise, the period between conducting a defensive operation and a subsequent offensive operation is a transition. These transition periods, and others like them, are typically times when an organization can recover and restore equilibrium.

[62] See Czerwinski, *Coping with the Bounds*, Beyerchen, "Clausewitz, Nonlinearity, and the Unpredictability of War," and Kolenda, "Uncertainty in War."

[63] There seems to exist, therefore, an organizational threshold for the management of transitions. Below a certain number of robust subordinate units, the organization cannot dominate both fights. The US Army, for instance, can employ cavalry forces to dominate transitions in war. These forces are traditionally organized and equipped to operate autonomously in a geographically dispersed manner to cover the entire battlespace of their parent unit. Intelligently employed, cavalry organizations give army divisions and corps the capability to dominate transitions and thus set the conditions to induce adverse nonlinear effects on the enemy.

[64] John Boyd, "Conceptual Spiral," Lecture to Naval War College Faculty (Newport, RI: Naval War College, August 1990). For further discussion of Boyd see Grant Tedrick Hammond, *The Mind of War: John Boyd and American Security* (Washington D.C.: Smithsonian Institute Press, 2001).

[65] The British and the French, the technological leaders in mechanized systems during the interwar period, were not the ones that implemented the concepts of "blitzkrieg" or "Deep Battle." When it came time to practice mechanized warfare in May 1940, the side with the technologically superior tanks lost to the side that employed inferior and fewer machines more effectively. While the Germans and Soviets were conceptualizing the power of deep penetrations by mechanized formations supported by artillery and aviation, the British and French focused on the employment of "penny-packets" of tanks to plug holes in defensive positions. See Robert Allan Doughty, *The Breaking Point, Sedan and the Fall of France, 1940* (Hamden, CT: Archon Books, 1990), 7-32; and *The Seeds of Disaster: The Development of French Army Doctrine, 1919-1939* (Hamden, CT: Archon Books, 1985); and Frederick W. Kagan, "Soviet Operational Art: Theory and Practice of Initiative, 1917-1945," in Kolenda ed., *Leadership: The Warrior's Art.*

[66] The Marine Corps has captured these ideas most effectively. See Fleet Marine Field Manual 1, *Warfighting* (Washington D.C.: US Government Printing Office, 1997); Lieutenant General Paul Van Riper, Congressional Testimony before the Procurement Subcommittee and Research and Development Subcommittee of the House National Security Committee, 20 March 2001; and H.T. Hayden ed., *Warfighting: Maneuver Warfare in the U.S. Marine Corps* (London: Greenhill Books, 1995).

[67] See Christopher D. Kolenda, "Discipline: Creating the Foundation for an Initiative-Based Organization," in Kolenda ed., *Leadership the Warrior's Art.*